

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Steven E. Ready et al.

Application No.: 10/824,994

Art Unit.: 2853

Filing Date: 04/14/2004

Examiner: Lam S. Nguyen

For: "Method For The Printing Of Homogeneous Electronic Material With A Multi-Ejector Print Head"

Mail Stop Appeal Brief-Patents

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Date: January 8, 2007

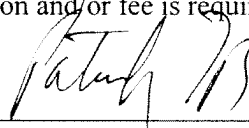
APPEAL BRIEF TRANSMITTAL

1. Transmitted herewith is an Appeal Brief for this application.
2. **STATUS:** Applicant is other than a small entity.
3. **EXTENSION OF TERM:** The proceedings herein are for a patent application and the provisions of 37 C.F.R. 1.136 apply. Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition for extension of time.
4. **FEE FOR CLAIMS:** The fee for claims (37 C.F.R. 1.16(b)-(d)) has been calculated as shown below:

	(Col.1)		(Col. 2)		(Col. 3)	LARGE ENTITY	
	Claims Remaining After Amendment		Highest No. Previously Paid For		Present Extra	Rate	Addit. Fee
Total	11	Minus	20	= 0		x \$50 =	\$0
Indep.	1	Minus	3	= 0		x \$200 =	\$0
First Presentation of Multiple Dependent Claim						+ \$360 =	\$0
Total						Addit. Fee	\$0

No additional fee for claims is required.

5. **FEE PAYMENT and DEFICIENCY:** Please charge Deposit Acct. 24-0037 the amount of \$500.00 for the Appeal Brief. If any additional extension and/or fee is required, also charge Account No. 24-0037.



SIGNATURE OF PRACTITIONER

Patrick T. Bever

Reg. No. 33834

Customer No. 33726

Tel.: (408) 451-5902

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant: Steven E. Ready et al.
Assignee: Palo Alto Research Center Incorporated
Title: Method for the Printing of Homogeneous
Electronic Material with a Multi-Ejector Print
Head
Serial No.: 10/824,994 File Date: 04/14/2004
Examiner: Lam S. Nguyen Art Unit: 2853
Docket No.: A2242-US-DIV (XCP-030-1D)

San Jose, CA
January 8, 2007

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

This Appeal Brief, filed in triplicate, is in support of
the Notice of Appeal dated November 7, 2006.

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I. REAL PARTY IN INTEREST

The real party in interest is the assignee, Palo Alto Research Center, Inc., pursuant to the Assignment recorded in the U.S. Patent and Trademark Office on August 20, 2002 on Reel 013218, Frame 0113.

II. RELATED APPEALS AND INTERFERENCES

Based on information and belief, there are no other appeals or interferences that could directly affect or be directly affected by or have a bearing on the decision by the Board of Patent Appeals in the pending appeal.

III. STATUS OF CLAIMS

Claims 10-20 are pending and stand rejected.

Claims 10-20 are appealed.

Claims 10-20 are listed in the Claims Appendix.

IV. STATUS OF AMENDMENTS

Appellant filed a response to the Second Non-Final Office Action on May 24, 2006. The amendments entered in that response were entered by the Examiner, as indicated by the Examiner in the Final Office Action dated August 7, 2006.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

This appeal involves independent Claim 10, and the subject matter of this claim finds exemplary support in the specification and drawings as follows:

<u>SUBJECT MATTER</u>	<u>SPECIFICATION</u>	<u>DRAWINGS</u>
10. A printing system comprising:	Paragraph 0038, printing system 200.	Fig. 2
a stage for supporting a substrate;	Paragraph 0038, stage 210 Paragraph 0054, stage 510	Fig. 2 Figs. 5a, 5b, 6a, 6b
a print head including: an ejector base, and a plurality of ejectors mounted in the ejector base;	Paragraph 0038, print head 230, base 231, ejectors 240 Paragraph 0050, print head 430b, base 431b, ejectors 440 Paragraph 0051, print head 430c, base 431b, ejectors 440 Paragraphs 0054 and 0055, print head 530, base 531, ejectors 540(x)	Fig. 2 Fig. 4b Fig. 4c Figs. 5a, 5b, 6a, 6b
means for moving the print head in a first print direction and a second print direction across a substrate without changing a rotational orientation of the print head relative to the substrate, the first print direction and the second print direction being nonparallel; and	Paragraphs 0038 and 0039, computer/workstation 290, printing support structure 280, stage 210; see also paragraph 0044 and 0045 ("print direction" defined)	Figs. 2, 3a
means for causing the plurality ejectors to	Paragraphs 0038 and 0039,	Figs. 2, 3a

selectively eject material toward the substrate when the print head is moving in the first printing direction and for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second printing direction,	computer/workstation 290, printing support structure 280, stage 210; see also paragraph 0044 and 0045 ("print direction" defined)	
wherein the first plurality of ejectors are arranged on the ejector base in a first line, the first line being diagonal to the first print direction and the second print direction.	Paragraph 0050, print head 430b, base 431b, ejectors 440 also: Paragraph 0051, print head 430c, base 431b, ejectors 440 also: Paragraphs 0054 and 0055, print head 530, base 531, ejectors 540(x)	Fig. 4b Fig. 4c Figs. 5a, 5b, 6a, 6b

VI. GROUNDS FOR REJECTION TO BE REVIEWED ON APPEAL

The following rejections are presented to the Board of Appeals for decision:

1. Claims 10-11 and 15 are rejected under 35 USC 103(a) as being unpatentable over USP 6390597 (herein "Fujimoto") in view of JP 2001232826A (herein "Muto").

2. Claims 10, 13 and 15-20 are rejected under 35 USC 103(a) as being unpatentable over USP 2002/0105688 (herein Katagami) in view of Muto.

3. Claim 12 is rejected under 35 USC 103(a) as being unpatentable over Fujimoto in view of Muto, and further in view of USP 5936648 (herein "Minowa").

4. Claim 14 is rejected under 35 USC 103(a) as being unpatentable over Katagami in view of Muto, and further in view of legal precedent.

VII. ARGUMENTS

Claims 10 is patentable under 35 U.S.C. 103(a) over either Fujimoto or Katagami in view of Muto

Claim 10 recites (in pertinent part; emphasis added):

A printing system comprising:

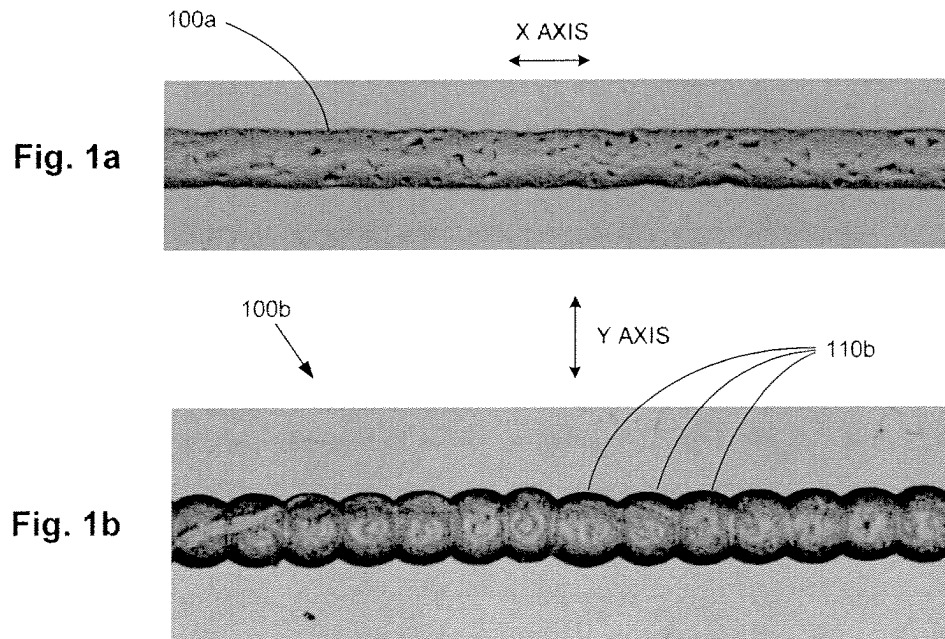
...means for moving the print head in a first print direction and a second print direction across a substrate without changing a rotational orientation of the print head relative to the substrate, **the first print direction and the second print direction being nonparallel;** and

means for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the first printing direction and for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second printing direction,

wherein the first plurality of ejectors are arranged on the ejector base in a first line, the first line being diagonal to the first print direction and the second print direction.

The structure recited in Claim 10 is generally directed to Integrated Circuit (IC) printing, which is an emerging technology that attempts to reduce the costs associated with IC production by replacing expensive lithographic processes with simple printing operations (see Applicants' paragraph 0003). Conventional IC printing typically involves depositing a print solution (generally an organic material) by raster bitmap along a single axis (the "print travel axis") across a solid substrate (see paragraph 0004). As described in Applicant's paragraph 0006, if first and second droplets are applied onto the substrate within a time prior to the phase transformation of the first droplet, the second droplet will wet and coalesce to the first droplet in its liquid or semi-liquid state to form a continuous printed

feature. Fig. 1a (copied below) shows a photograph of a printed feature 100a that was printed in a single printing pass in the X axis direction. Because adjacent droplets deposited during the single printing pass did not have time to dry between ejection events, feature 100a exhibits the desired homogeneity and smooth side wall profiles that result from optimal droplet coalescence. In contrast, Fig. 1b shows a photograph of a printed feature 100b formed by raster printing in the Y axis direction. Feature 100b therefore represents a "multi-pass" feature; i.e., a printed feature formed by multiple passes of the print head. In a multi-pass feature, the droplets deposited during sequential passes of the print head are typically dry before any adjacent droplets from the next printing pass are deposited. Consequently, the drops of print solution that make up the multi-pass feature are not able to coalesce and therefore create "scalloped" feature borders. This edge scalloping can be seen in Fig. 1b, as the individual print solution droplets 110b used to form feature 100b are all clearly visible:



As further described in Applicants' paragraph 0007, utilizing printing systems that print in only one direction (e.g., the X axis direction) produce IC patterns that exhibit the undesirable edge scalloping and non-coalescence shown in Fig. 1(b):

[0007] Typically, an IC pattern includes both multi-pass features and features that are aligned with the print direction. Fig. 1c shows a photograph of an IC pattern 100c printed using a conventional IC printing process - in this case a raster printing operation in the Y axis direction. IC pattern 100c is made up of an array of transistor elements 120 interconnected by multiple address lines 160 and word lines 170. Word lines 170, which run parallel to the Y axis and were therefore aligned with the print direction, exhibit the desirable homogeneity and smooth sidewalls described with respect to Fig. 1a. However, address lines 160, which are printed by multiple printing passes in the Y axis direction, all exhibit the undesirable edge scalloping and non-coalescence described with respect to Fig. 1b.

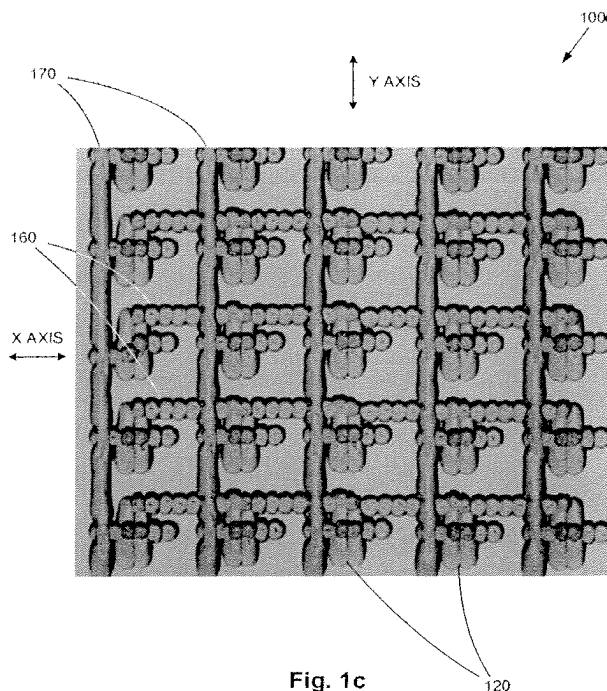


Fig. 1c
(PRIOR ART)

The structure of Claim 10 overcomes the problems described above by facilitating printing in two non-parallel directions, for example, as described in paragraph 0050 and shown in Applicants' Fig. 4, both copied below:

[0050] Fig. 4b shows a bi-axial print head in accordance with another embodiment of the invention. Print head 430b includes multiple ejectors 440 arranged in a diagonal line across an ejector base 431b. Note that while six ejectors are shown for explanatory purposes, print head 430b could include any number of ejectors. The diagonal ejector arrangement of print head 430b allows multi-line printing to be performed in both the X axis and Y axis directions without print head or substrate rotation. Note that the throughput capability of print head 431b can be further optimized by setting the horizontal spacing Hb and the vertical spacing Wb between ejectors 440 according to the design rules of the IC layout being printed, as described previously with respect to print head 430a shown in Fig. 4a.

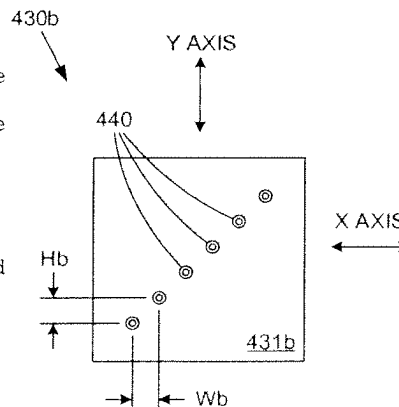


Fig. 4b

As described, for example, in Applicants' paragraph 0046 (copied below with Fig. 3d), the structure recited in Claim 10 facilitates the production of a printed pattern including homogenous printed patterns formed by a series of printing operations, wherein the print direction of each printing operation is aligned with the parallel layout features of the design layer being printed:

[0046] Fig. 3d shows a photograph of an IC pattern 300d that could be printed from design layers 300b and 300c in Figs. 3b and 3c, respectively. Note that word lines 360 of IC pattern 300d, which were formed by a printing operation having a print direction parallel to the Y axis, all exhibit the desired smooth edges and homogeneity previously described with respect to printed feature 100a shown in Fig. 1a. Similarly, note that address lines 370, which were formed by a printing operation having a print direction parallel to the X axis, are likewise smooth-edged and homogenous. In this manner, division of IC layouts into appropriate design layers can enable improved printing of IC patterns. Contrast the smooth-edges of IC pattern 300d with the scalloped edges of IC pattern 100c shown in Fig. 1c, which was formed using a conventional printing method.

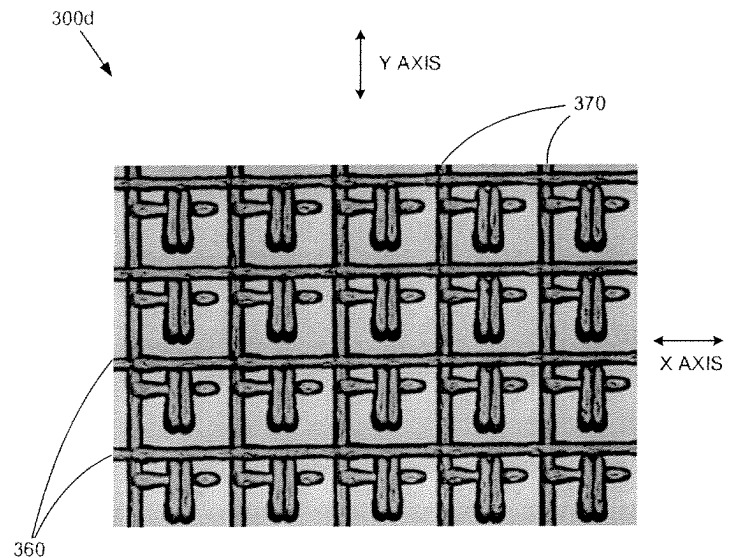


Fig. 3d

- a) The pending rejections clearly rely on Muto to teach printing in two non-parallel directions

In rejections 1 and 2 (listed above), the Examiner admits that neither Katagami nor Fujimoto disclose "means for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the first printing direction and for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second printing direction". Specifically, on page 3 of the final Office

action, the Examiner state:

Fujimoto et al., however, does not disclose wherein said means for causing the plurality ejectors causes the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second direction.

Similarly, on page 5 of the final Office Action, the Examiner states:

Katagami et al., however, does not disclose wherein said means for causing the plurality ejectors causes the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second direction.

In each case, the Examiner then relies on Muto to meet the missing limitation (see both pages 3 and 5):

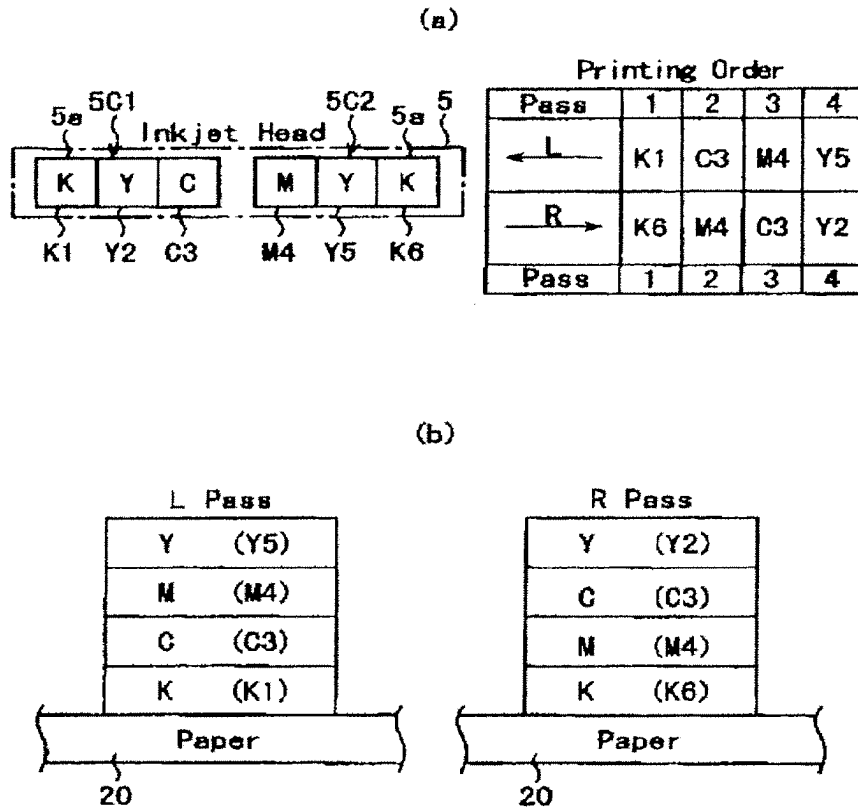
MUTO discloses an inkjet printer including an inkjet head comprising a plurality of ejectors (nozzles) selectively discharging color inks during the movement of the inkjet printhead in main and sub-scanning directions (first and second directions) (*Abstract*).

The Examiner then argues that it would have been obvious to combine the teachings of Funjimoto/Kanigawa and Muto "to prevent overlap of color inks by controlling the ink discharge order as taught by Muto" (see pages 3 and 5).

b) Muto clearly fails to teach printing in two non-parallel directions

Applicant respectfully traverses the pending rejections of Claim 10 at least because Muto fails to teach or suggest "means for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the first printing direction and...when the print head is moving in the second printing direction" wherein "the first print direction and the second print direction

being nonparallel...", as recited in Claim 10. In contrast to Claim 10, the figures published with Muto's abstract (copied below for reference) depict two parallel printing directions "R" and "L":



Further, Applicant submits herewith (see Evidence Appendix, below) a machine-translated copy of Muto obtained from Patent and Utility Model Gazette DB, web address <http://www4.ipdl.ncipi.go.jp/Tokujitu/tjsogodben.ipdl?N0000=115>. The machine-translated copy appears to consistently refer to the printing directions as being "Left" and "Right", i.e., parallel directions. As such, Applicant respectfully traverses the above-listed rejections directed to Claim 10 because Muto does not appear to teach "means for moving the print head in a first print direction and a second print direction across a substrate without changing a rotational orientation of the print head relative to the substrate, the

first print direction and the second print direction being nonparallel", as recited in Claim 10.

- c) The Examiner's argument raised in the Advisory Action either contradicts the pending rejection, or improperly raises new grounds for rejection

The Examiner enters the following statement on page 2 of the Advisory Action dated October 11, 2006:

Continuation of 11. does NOT place the application in condition for allowance because: The applicant argued that MUTO did not appear to teach "means for moving the print head in a first print direction and a second print direction across a substrate without changing a rotational orientation of the print head relative to the substrate, the first print direction and the second print direction being nonparallel". It is the examiner's point of view that the MUTO reference was not used in the last office action for teaching of the above claim limitation. The claim limitation, in fact, is taught by the Fujimoto reference and the Katagami reference as clearly discussed in the last office action.

The above-quoted statement appears to contradict the rejections of Claim 10 over Fujimoto and Katagami (copied above) because, in direct contradiction to the above-quoted language from the final Office Action, the Examiner clearly admits that Fujimoto and Katagami do "not disclose wherein said means for causing the plurality of ejectors causes the plurality of ejectors to selectively eject material toward the substrate when the print head is moving in the second direction", and that Muto is cited because it discloses the deficiencies of Fujimoto and Katagami. In view of the language of the final rejection, the Examiner's statement in the Advisory Action either contradicts the final Office Action, or appears to raise new grounds for rejection, which is not proper.

- d) Claims 11-20 depend from Claim 10, and none of the additional references overcome the deficiencies of Muto

Claims 11-20 are dependent from Claim 10, and are therefore distinguished over Fujimoto/Katagami in view of Muto for at least the reasons provided above with reference to Claim 10. In addition, Minowa does not overcome the deficiencies of Muto, and Applicant respectfully submits that

legal precedent cannot be relied upon to maintain the rejection.

For the foregoing reasons, it is submitted that the Examiner's rejections of Claims 10-20 are erroneous, and reversal of these rejections is respectfully requested.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Patrick T. Bever". The signature is stylized with a large, looped "P" and a trailing flourish.

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VII. CLAIMS APPENDIX

10. (previously presented) A printing system comprising:

- a stage for supporting a substrate;

- a print head including:

- an ejector base, and

- a plurality of ejectors mounted in the ejector base;

- means for moving the print head in a first print direction and a second print direction across a substrate without changing a rotational orientation of the print head relative to the substrate, the first print direction and the second print direction being nonparallel; and

- means for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the first printing direction and for causing the plurality ejectors to selectively eject material toward the substrate when the print head is moving in the second printing direction,

- wherein the first plurality of ejectors are arranged on the ejector base in a first line, the first line being diagonal to the first print direction and the second print direction.

11. (previously presented) The printing system of Claim 10, wherein the first print direction and the second print direction are orthogonal.

12. (previously presented) The printing system of Claim 11, wherein the first line is at a 45° angle with respect to the first print direction and the second print direction.

13. (previously presented) The printing system of Claim 10, further comprising means for causing the print head to print an IC pattern on the substrate, wherein a first spacing between each of the first plurality of ejectors in the first print direction is an integer multiple of a first design rule of the IC pattern, and wherein a second spacing between each of the first plurality of ejectors in the second print direction is an integer multiple of a second design rule of the IC pattern.

14. (previously presented) The printing system of Claim 13, wherein the first design rule is the same as the second design rule.

15. (previously presented) The printing system of Claim 10, further comprising a second plurality of ejectors mounted in the ejector base, the second plurality of ejectors being arranged in a second line, the second line being parallel to the first line, wherein each of the first plurality of ejectors and the second plurality of ejectors has a unique position in the first print direction.

16. (previously presented) The printing system of Claim 15, further comprising a third plurality of ejectors mounted in the ejector base, the third plurality of ejectors being arranged in a third line, the third line being parallel to the first line, wherein each of the first plurality of

ejectors and the third plurality of ejectors has a unique position in the second print direction.

17. (previously presented) The printing system of Claim 10, further comprising means for causing the plurality of ejectors to print a phase change material for a semiconductor process mask.

18. (previously presented) The printing system of Claim 10, further comprising means for causing the plurality of ejectors to print a solution-processable electronic materials to form an integrated circuit.

19. (previously presented) The printing system of Claim 10, further comprising means for aligning the plurality of ejectors to the substrate before causing the plurality of ejectors to selectively eject said material toward the substrate.

20. (previously presented) The printing system of Claim 19, wherein said means for aligning comprises a camera mounted on said means for moving.

IX. EVIDENCE APPENDIX

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-232826

(43)Date of publication of application : 28.08.2001

(51)Int.Cl.

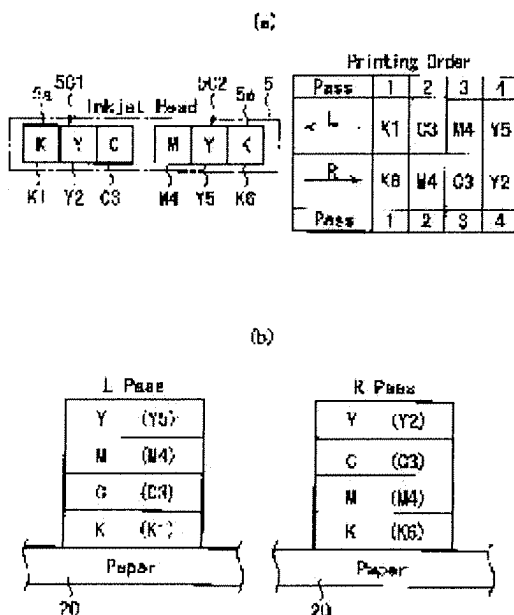
B41J 2/21

B41J 2/01

(21)Application number : 2000-047821 (71)Applicant : MUTOH IND LTD

(22)Date of filing : 24.02.2000 (72)Inventor : CHRISTOPHER M BROWN

(54) INK-JET PRINTER



ent a color tone change by a color overlap order an ink-jet printer.

of nozzles for discharging inks of a darkest color, a of these colors are set as ink-jet nozzles of an ink-jet head moves in any horizontal direction, ink-jet nozzles are positioned to the downstream of the color ink, or nozzles for discharging the darkest of the nozzles for discharging the intermediate using the overlap order of inks at positions where the ed, and band mottle and the color tone change can

LEGAL STATUS

[Date of request for examination] 04.09.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other

than the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number] 3645776

[Date of registration] 10.02.2005

[Number of appeal against examiner's
decision of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink jet printer from which color tone change of the contiguity swath at the time of performing especially bidirectional printing (the so-called band) is reduced and removed about the ink jet printer designed in order to print a color picture using the color defined by the subtractive-color-mixture color model.

[0002]

[Description of the Prior Art] Methods, such as an ink jet type, a laser beam type, a sensible-heat type, and a hot printing type, are learned as a raster plotter conventionally used as the printer used as output units, such as a computer and a word processor, or an output unit of a CAD system.

[0003] In it, an ink jet-type printer can be printed from a print head by the ability breathing out ink to a print sheet etc., and can print a high definition image etc. at high speed. Most this ink jet printer for printing the image with which it generally spread through first in a roll widely, and especially the computer processed the color printer of the type which carries out the regurgitation of the ink of **** to the spread of computers in recent years from a print head conjointly with multicolor many gradients is used.

[0004] In such an ink jet printer, printing is performed by sending a record form in the direction (the direction of vertical scanning) which intersects perpendicularly with a main scanning direction, moving a print head in the direction (main scanning direction) which crosses a record form, and printing the range which can be printed by one scan. Generally a print head consists of two or more head segments located in a line with the main scanning direction, and each head segment is prepared corresponding to the color of each ink. Each head segment is equipped with two or more nozzles which changed the location of the direction of vertical scanning. Color printing follows a subtractive-color-mixture model. A subtractive-color-mixture model is typically expressed with the combination (CMYK) which added black (K) ink to the combination (CMY) of cyanogen (C), a Magenta (M), and yellow (Y) ink, and this combination. Moreover, in addition to CMYK, the combination of a thin Magenta (Light Magenta:LM), thin cyanogen (Light Cyan:LC), thin black or such combination, and spot color, such as a vermilion, green, red, and blue, etc. is known as a subtractive-color-mixture model as an extended edition of such combination.

[0005] The present most general print head configuration of an ink jet printer is 4 head segment configuration of 1 head segment per color, for example, when one-way printing is carried out, black (K) ink adheres to a print sheet first, subsequently to a it top cyanogen (C) and Magenta (M) ink are breathed out, and the printer head by which the nozzle configuration was carried out in the sequence of KCMY so that yellow (Y) ink might finally adhere is adopted.

[0006] In order to shorten printing time amount compared with one-way printing, when carrying out bidirectional printing, contrary to the time of a **** scan, yellow (Y) ink adheres first, a Magenta (M) and cyanogen (C) ink will adhere on it, finally black (K) ink

will adhere, and the printing swath at the time of a double-acting scan will be made from this print head.

[0007] In this way, in the image quality of the result obtained by bidirectional printing, color tone change is noticeable between contiguity swaths. It is because the swath by which the reason was printed in order of KCMY ink looks bright to human being's eyes rather than the swath printed in order of YMCK. This fact is drawn from having the lightness from which extent which four colors of the criterion used for subtractive color mixture can identify by human being's eyes, respectively differs.

[0008] It thinks based on the knowledge of being made by subtractive-color-mixture processing in which the optimal color reproduction by the printing approach of the order of KCMY makes the black (K) of the darkest color adhere to a print sheet first, and makes the cyanogen (C) of a color brighter than black adhere on it. For example, in the case of 6 color printing system which added LC and LM to KCMY, it can consider making these two newly applied colors adhere ahead of Y as sequence of the ink layer for the optimal color reproduction.

[0009] By the way, in order to heighten goods competitive strength, meeting a quick shipment demand of a commercial scene, the price fall demand, etc., the balance of the image quality which it is the printing time amount in an ink jet printer and as a result of [its] printing must be considered. Therefore, many ink jet printers have equipped bidirectional printing mode standardly, and can decrease in number printing time amount 25% to 30% in that case compared with an one-way print mode.

[0010]

[Problem(s) to be Solved by the Invention] However, although surely the printing approach in bidirectional printing mode shortens printing time amount, the increment in a print speed will be attained by usually sacrificing image quality, will generate the so-called band spots as a stripe which is conspicuous through the whole image or a part, and will spoil image quality as a result. Although the band spots in this phenomenon can be reduced by printing by interleave, the problem of being completely unremovable has them.

[0011] Here, the contents are explained using drawing 9 A - 9C. This drawing is drawing which expressed the logical model in the case of carrying out interleave printing by horizontal resolution 360dpi using the print head to which the dot was perpendicularly located in a line at intervals of 1/180 inch. First, as shown in drawing 9 A, when the print head 100 ***** in the 1st direction (drawing Nakaya mark R1 direction), the ink nozzle 101 carried in the print head 100 injects ink, and carries out printing of horizontal resolution 360dpi and vertical definition 180dpi as a result. At the time of *****, the printing sequence of ink over all dots is KCMY, and the bright color is printed at the end.

[0012] Next, as shown in drawing 9 B, when the print head 100 ***** in the 2nd direction (drawing Nakaya mark L1 direction), the print head 100 shifts only the specified quantity, and the ink injected from the ink nozzle 101 is printed by horizontal resolution 360dpi and vertical definition 180dpi, and creates level and the swath SWT1 of vertical definition 360dpi by ***** and ***** as a result. In addition, at the time of *****, the printing sequence of ink over all dots is YMCK, and the dark color is printed at the end.

[0013] Furthermore, as shown in drawing 9 C, when the print head 100 ***** in the 1st direction (drawing Nakaya mark R 2-way) again, the print head 100 shifts only the specified quantity further, and the ink injected from the ink nozzle 101 is printed by

horizontal resolution 360dpi and vertical definition 180dpi like the above-mentioned, and creates level and the swath SWT2 of vertical definition 360dpi by ***** and ***** as a result. The printing sequence of ink over all the dots at the time of this ***** is KCMY, and an again bright color will be printed at the end.

[0014] If the above-mentioned logical model is seen, since the interlace of light-and-darkness each lightness is carried out perpendicularly equally by each swath, as for each swath, it seems to have removed color tone change of a contiguity swath by interleave. However, although it is few fields, the so-called dot gain of overwriting a contiguity dot exists in this logical model.

[0015] Dot gain is generated by increasing the diameter, when the ink droplet of a certain magnitude dries on the surface of the matter. This dot gain is required in order to make image quality the optimal, or in order to ensure color saturation. For example, if there is no suitable dot gain, the front face (generally white) of the substrate of a print sheet can be seen from the clearance between a dot and a dot, and, as for a printing image, will look like the so-called "WOSSHUDO out."

[0016] Drawing 10 is drawing for explaining the dot gain in the above-mentioned logical model in detail. As shown in this drawing (a), the low dot D2 of lightness is overwritten on the high dot D1 of lightness, it becomes a dark impression and dot gain when the print head 100 carries out ***** appears in human being's eyes so that printing result 110a may see consequently. Moreover, conversely, as shown in this drawing (b), the high dot D1 of lightness is overwritten on the low dot D2 of lightness, it becomes a bright impression and the dot gain when carrying out ***** whose print head 100 is the 2nd time appears so that printing result 110b may see. As for the image finally printed in such printing actuation, the swath SWT1 when the print head 100 carries out actuation (L1, L2, ..., Ln) to the left from the right looks darkly, and it is said brightly that its swath SWT2 when carrying out actuation (R1, R2, ..., Rn) to the right from the left can be seen. A vertical high resolution is realized by fine interleave of each printing swath, and the inclination which stops being able to be conspicuous easily has color tone change by the printer with more high resolution. However, in such a case, it also sets and color tone change of the band spots between contiguity swaths etc. is still seen.

[0017] This invention was made in view of such a trouble, and aims at offering the ink jet printer which prevents effectively the band spots resulting from change of the order of a color pile when carrying out bidirectional printing, and color tone change.

[0018]

[Means for Solving the Problem] The ink jet head which comes to arrange two or more nozzles which carry out the regurgitation of the ink of a color in which the ink jet printers concerning this invention differ in a main scanning direction, respectively, While driving this ink jet head relatively [direction / of vertical scanning / which intersects perpendicularly with said main scanning direction and this to print media] It has the head control means which outputs the regurgitation pulse for the ink regurgitation to said ink jet head synchronizing with the drive of said ink jet head. In the ink jet printer which lays the ink droplet breathed out from the nozzle of each color of said ink jet head on top of each dot formation location of said print media, and forms a color picture in it Said ink jet head So that the nozzle which carries out the regurgitation of the ink of the brightest color may be located in the lower stream of a river of the nozzle which carries out the regurgitation of

the ink of the color of middle lightness even when it moves to which sense of said main scanning direction It comes to arrange at least two or more one side of the nozzle which carries out the regurgitation of the ink of the color of the nozzle which carries out the regurgitation of the ink of said brightest color, and said middle lightness. Said head control means When said ink jet head is moving said main scanning direction to the 1st sense, It becomes the combination from which the nozzle which carries out the regurgitation of the ink of the color of said middle lightness and the brightest color in the time of moving to the 2nd sense opposite to this differs. And the nozzle which carries out the regurgitation of the ink of the color of said middle lightness to the same dot location in any [of said 1st and 2nd sense] case, It is characterized by being what outputs a regurgitation pulse to said ink jet head so that ink may be breathed out in order of the nozzle which carries out the regurgitation of the ink of said brightest color.

[0019] The following can be considered as an ink jet head of the ink jet printer concerning this invention. That is, even when the 1st ink jet head moves to which sense of said main scanning direction preferably, it comes to arrange in a main scanning direction at least two or more one side of the nozzle which carries out the regurgitation of the ink of the color of the nozzle which carries out the regurgitation of the ink of said darkest color so that the nozzle which carries out the regurgitation of the ink of the darkest color may be located in the upstream of the nozzle which carries out the regurgitation of the ink of the color of middle lightness, and said middle lightness.

[0020] In this case, when said ink jet head is moving said main scanning direction to the 1st sense, after said head control means outputs a regurgitation pulse to the nozzle which carries out the regurgitation of the ink of said darkest color, it is desirable that it is what outputs a regurgitation pulse to the nozzle which carries out the regurgitation of the ink of the color of said middle lightness.

[0021] Moreover, the 2nd ink jet head is a nozzle to which it consists of six head segments on a par with said main scanning direction which consisted of two or more nozzles with which each changed the location of the direction of vertical scanning, and it has 2 sets of two head segments which carry out the regurgitation of the ink of the darkest color and the brightest color, respectively, each class is arranged outside preferably, respectively, and two inside head segments carry out the regurgitation of the ink of the color of middle lightness.

[0022] In this case, as for said head control means, it is desirable that it is what outputs a regurgitation pulse in order of the head segment which carries out the regurgitation of the ink of the darkest color of the group to precede about the same dot formation location, the head segment which carries out the regurgitation of the ink of the color of middle lightness, and the head segment which carries out the regurgitation of the ink of the brightest color of a back group.

[0023] Furthermore, the 3rd ink jet head is a head segment to which it consists of four head segments preferably on a par with said main scanning direction, two head segments which carry out the regurgitation of the ink of the brightest color are arranged outside, respectively, and two inside head segments carry out the regurgitation of the ink of the color of middle lightness.

[0024] In this case, as for said head control means, it is desirable that it is what outputs a regurgitation pulse about the same dot formation location in order of the head segment

which carries out the regurgitation of the ink of the color of middle lightness, and the head segment which carries out the regurgitation of the ink of the brightest color behind that.

[0025] As a color of the ink breathed out from the nozzle of the ink jet head of the ink jet printer concerning this invention, it is desirable for said brightest color to be [for the colors of yellow (Y) and said middle lightness] cyanogen (C) and a Magenta (M).

[0026] In addition, for said darkest color, as a color of the ink breathed out from the nozzle of said 1st and 2nd ink jet heads, black (K) and said brightest color may be [the color of yellow (Y) and said middle lightness] cyanogen (C) and a Magenta (M).

[0027] Moreover, as a color of the ink breathed out from the nozzle of said 2nd ink jet head, the darkest color is black (K), and in that case, said head control means outputs a regurgitation pulse by turns to the head segment of the black contained in said each class at the time of monochrome printing, and realizes printing of a twice [at the time of color printing] as many rate as this.

[0028] According to this invention, the array of the ink nozzle of the ink jet head in an ink jet printer is changed, and it becomes possible to print maintaining the regurgitation sequence of ink to the same dot location by controlling the regurgitation sequence of ink, even when an ink jet head moves in which direction of a main scanning direction. Thereby, the band spots which originate in order of the color pile of ink can be decreased or removed.

[0029]

[Embodiment of the Invention] Hereafter, the example of this invention is explained with reference to a drawing. Drawing 1 is the block diagram showing a part of configuration of the ink jet printer concerning one example of this invention.

[0030] Image data which should be carried out a printout, such as TIFF, JPEG, MR, MMR, CALS, etc. which are sent from the host system which is not illustrated, is supplied to CPU1. By decode processing, color transform processing, gradation processing, etc., the inputted image data is changed into bit map data, and CPU1 memorizes it in the bit map memory 2. The bit map data memorized by the bit map memory 2 are printed out on the print sheet which is not illustrated by the ink jet head 5 driven by control of the head control section 7. The head control section 7 is constituted by the gate array circuit 3, the head mechanical component 4, and the timing fence section 6. The gate array circuit 3 outputs the timing signal for a head drive to the head mechanical component 4. The head mechanical component 4 drives a print sheet in the direction (the direction of vertical scanning) which intersects perpendicularly with a main scanning direction while driving the ink jet head 5 in the direction (main scanning direction) which crosses a print sheet based on this timing signal. The timing fence section 6 detects the location of the ink jet head 5 including a linear encoder, and the ink jet head 5 outputs the timing fence signal TP to the gate array circuit 3, whenever only the specified quantity moves to a main scanning direction. The gate array circuit 3 outputs a timing signal to the head mechanical component 4 based on this timing fence signal TP. The gate array circuit 3 outputs the regurgitation pulse FP which gives the regurgitation timing of ink to the ink jet head 5 again based on the timing fence signal TP.

[0031] Drawing 2 is drawing for explaining the motion of the ink jet head 5 to a print sheet 20.

[0032] The both-way drive of the ink jet head 5 is carried out in the main scanning

direction of a print sheet 20. A print sheet 20 drives in the direction of vertical scanning, respectively at the time of termination of ***** of the ink jet head 5, and termination of ***** . The ink jet head 5 consists of two or more head segment 5a which carries out the regurgitation of the ink of a different color together with a main scanning direction. One head segment 5a consists of two or more nozzle 5b which carries out the regurgitation of the ink of the same color, as shown in drawing 3 . Although you may stand in a line in the direction of vertical scanning at the single tier, in order to make arrangement of a nozzle easy, like illustration, these nozzle 5b changes one nozzle of locations of a main scanning direction at a time, and is arranged in the shape of a hound's-tooth check.

[0033] Drawing 4 is drawing showing the 1st example of a configuration and its example of a drive of the ink jet head 5 in this equipment.

[0034] As shown in this drawing (a), this ink jet head 5 consists of two head segment group 5C 5C [1 and]2 located in a line with the main scanning direction. One head segment group 5C1 consists of three head segment 5a (K1, Y2, C3) which carries out the regurgitation of the ink of each color of KYC. Head segment group 5C2 of another side consists of three head segment 5a (M4, Y5, K6) which carries out the regurgitation of each color of MYK. In addition, each head segment 5a can be driven independently, respectively. 3 color combined head in which each has three head segment 5a is sufficient as head segment group 5C 5C [1 and]2. when the ink jet head 5 moves in the direction of drawing Nakaya mark L (the left from the right -- migration: -- it is hereafter called about L lines.), as shown in discharge and this drawing (b), the lap of ink prints [the head segments K1, C3, M4, and Y5] KCMY for ink on a print sheet 20 in order.

[0035] on the other hand, when moving in the direction of drawing Nakaya mark R (the right from the left -- migration: -- it is hereafter called about R lines.), the head segments K6, M4, C3, and Y2 perform ink in order, and discharge and the lap of ink print KMCY. usually, color tone change in which the combination (for example, as green as red) of a specific color was conspicuous at the time of bidirectional printing -- a lifting -- easy -- when also using the black (K) ink of still few amounts, it turns out that especially this phenomenon becomes remarkable. It follows, for example, the ink jet head of the conventional KCMY array is used, and the way which prints KCMY and KMCY by turns using the ink jet head 5 of a configuration like this example can say that color tone change becomes what is not conspicuous rather than printing by turns in order of KCMY and YMCK. That is, it is possible to be able to make color tone change of a contiguity swath into the minimum, and to remove color tone change over [almost] a total color by preventing reversing the color sequence of K and Y in a printing result.

[0036] In addition, the above is an example of 6 head segmental die, and can find out the same view for other examples of arrangement. For example, it consists of three head segment 5a (Y1, K2, C3) to which segment group 5C1 carries out the regurgitation of the ink of each color of YKC like drawing 5 (a). Even if segment group 5C2 consists of three head segment 5a (M4, K5, Y6) which carries out the regurgitation of the ink of each color of MKY In order, on the other hand, the head segments K2, C3, M4, and Y6 are not conspicuous [in ink / as for color tone change] by about L lines, like the case of the 1st example of the above, when head segment K5, and M4, C3 and Y1 carry out the regurgitation of the ink to sequence by about R lines, discharge and.

[0037] Moreover, it consists of three head segment 5a (K1, Y2, C3) to which segment

group 5C1 carries out the regurgitation of the ink of each color of KYC like drawing 5 (b) similarly. Even if segment group 5C2 consists of three head segment 5a (M4, K5, Y6) which carries out the regurgitation of the ink of each color of MKY By about L lines, as for color tone change, the head segments K1, C3, M4, and Y6 are not conspicuous, when head segment K5, and M4, C3 and Y2 make ink sequence and they make the regurgitation of the ink to sequence by discharge and about R lines.

[0038] In addition, as shown in drawing 6 , at the time of monochrome printing, it enables a drive of only the head segments K1 and K6 of the ink jet head 5 of drawing 4 , moves the ink jet head 5 on a frequency twice the rate of the ink regurgitation, and since the ink jet head 5 of 6 head segmental die mentioned above has head segment 5a of two K colors in the main scanning direction, it impresses a regurgitation pulse to it so that K1 and K6 may be operated by turns every other dot. Thereby, monochrome (monochrome) printing is usually attained at twice [about] as many high speed as a print speed.

[0039] in this case -- the time of about R lines [in / as shown in this drawing (a) / printing actuation] -- K6 carries out [a head K1] the regurgitation of the ink for ink to an even-dot train in that opposite dot train at an odd-dot train, respectively in the case of about L lines, as shown in discharge and this drawing (b), respectively. For example, what is necessary is just to arrange two print heads in one train so that one head may print an odd-dot train and another head may print an even-dot train in order to print with the nozzle pulse frequency of 8kHz (a 8000-/second / nozzle) of horizontal resolution 360dpi and to make this passing speed quick, although the passing speed (Head Transport Speed:HTS) of an ink jet head should just be 22.2 inches/second. High-speed monochrome printing with the passing speed of 44.4 inches/second can be carried out by impressing a pulse to K1 and K6 by turns using the result, for example, the above-mentioned model. However, using an ink jet head with equal number of ink jet nozzles and spacing of a nozzle, this approach can be realized, only when each nozzle has a drive circuit.

[0040] Drawing 7 is drawing showing other example of a configuration and its example of a drive of the ink jet head 5 in this equipment.

[0041] As shown in this drawing (a), this ink jet head 5 consists of four head segment 5a (Y1, C2, M3, Y4) which carries out the regurgitation of the ink of each color of YCMY. Usually, in many low-price ink jet printers, one compound print head with four print heads with the nozzle train of a single tier or four independent nozzle segments is equipped, the ink of C, M, Y, and K is mounted, and KCMY printing is performed. However, in the case where a photograph, a computer artwork, etc. are generated, the ink of K can completely say the need that there is nothing so that a raster image may be generated. In fact, the standard model of subtractive color mixture is the color of CMY, and is not CMYK. Although color of K is added for upgrading of a text print, an improvement of image contrast, etc., the approach of this example is devised in order to realize suitable balance of image quality and a print speed, after taking into consideration image upgrading by the color of K, and degradation of the image quality by the color tone error at the time of bidirectional printing.

[0042] As shown in this drawing (a), when the ink jet head 5 moves to about L lines, as shown in discharge and this drawing (b), the lap of ink prints [the head segments C2, M3, and Y4] CMY for ink on a print sheet 20 in order. On the other hand, when moving to about R lines, as shown in discharge and this drawing (b), the lap of ink prints [the head

segments M3, C2, and Y1] CMY for ink on a print sheet 20 in order. Consequently, the optimal bidirectional printing in the ink jet head 5 of a configuration of consisting of four print heads which do not carry the ink of K becomes possible.

[0043] In addition, the configuration of the ink jet head of the ink jet printer in this invention is not limited to what was mentioned above. For example, it consists of four head segment 5a (K1, C2, M3, Y4) to which one [as shown in drawing 8 (a)] head segment group 5C1 carries out the regurgitation of the ink of each color of KCMY. What [consists of four head segment 5a (Y5, M6, C7, K8) to which head segment group 5C2 of another side carries out the regurgitation of the ink of each color of YMCK] What consists of seven head segment 5a (K1, C2, M3, Y4, M5, C6, K7) which carries out the regurgitation of the ink of each color of KCMYMCK as shown in this drawing (b), Or it could consist of seven head segment 5a (Y1, M2, C3, K4, C5, M6, Y7) which carries out the regurgitation of the ink of each color of YMCKCMY as shown in this drawing (c). Moreover, you may consist of five head segment 5a (C1, M2, Y3, M4, C5) which carries out the regurgitation of the ink of each color of CMYMC as shown in this drawing (d) also as a configuration of the ink jet head 5 in which K is not carried, for example. What is necessary is in short, just to carry out two or more arrangement of the head segment which carries out the regurgitation of the ink of either the color of middle lightness, and the brightest color. It cannot be overemphasized that various ink jet head configurations can be considered from the above thing if it is the range which does not deviate from the summary of this invention.

[0044]

[Effect of the Invention] As stated above, according to this invention, the ink nozzle array of an ink jet printer is changed, and the effectiveness that the band spots and color tone change resulting from change of the order of a color pile when carrying out bidirectional printing can be effectively prevented by controlling regurgitation sequence is done so.

EFFECT OF THE INVENTION

[Effect of the Invention] As stated above, according to this invention, the ink nozzle array of an ink jet printer is changed, and the effectiveness that the band spots and color tone change resulting from change of the order of a color pile when carrying out bidirectional printing can be effectively prevented by controlling regurgitation sequence is done so.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing a part of configuration of the ink jet printer concerning one example of this invention.

[Drawing 2] It is drawing for explaining the motion of an ink jet head to the print sheet in this equipment.

[Drawing 3] It is drawing showing the example of arrangement of the nozzle of the ink jet head in this equipment.

[Drawing 4] It is drawing showing the 1st example of a configuration and its example of a drive of the ink jet head in this equipment.

[Drawing 5] It is drawing showing the example of arrangement of other head segments of the ink jet head in this equipment.

[Drawing 6] It is drawing showing the example of a drive at the time of monochrome printing with the ink jet head in this equipment.

[Drawing 7] It is drawing showing other example of a configuration and its example of a drive of the ink jet head in this equipment.

[Drawing 8] It is drawing showing the example of a configuration of further others of the ink jet head in this equipment.

[Drawing 9 A] It is drawing showing the logical model in the case of carrying out interleave printing with the conventional ink jet printer.

[Drawing 9 B] It is drawing showing the logical model in the case of carrying out this interleave printing.

[Drawing 9 C] It is drawing showing the logical model in the case of carrying out this interleave printing.

[Drawing 10] It is drawing of a ***** sake in detail about the dot gain in this logical model.

[Description of Notations]

1 [-- A head mechanical component 5 / -- An ink jet head, 6 / -- The timing fence section, 7 / -- A head control section, 100 / -- Print head.] -- CPU, 2 -- Bit map memory, 3 -- A gate array, 4

CLAIMS

[Claim(s)]

[Claim 1] The ink jet head which comes to arrange two or more nozzles which carry out the regurgitation of the ink of a color which is different in a main scanning direction, respectively, While driving this ink jet head relatively [direction / of vertical scanning / which intersects perpendicularly with said main scanning direction and this to print media] It has the head control means which outputs the regurgitation pulse for the ink regurgitation to said ink jet head synchronizing with the drive of said ink jet head. In the ink jet printer which lays the ink droplet breathed out from the nozzle of each color of said ink jet head on top of each dot formation location of said print media, and forms a color picture in it Said ink jet head So that the nozzle which carries out the regurgitation of the ink of the brightest color may be located in the lower stream of a river of the nozzle which carries out the regurgitation of the ink of the color of middle lightness even when it moves to which sense of said main scanning direction It comes to arrange at least two or more one side of the nozzle which carries out the regurgitation of the ink of the color of the nozzle which carries out the regurgitation of the ink of said brightest color, and said middle lightness. Said head control means When said ink jet head is moving said main scanning direction to the 1st sense, It becomes the combination from which the nozzle which carries out the regurgitation of the ink of the color of said middle lightness and the brightest color in the time of moving to the 2nd sense opposite to this differs. And the nozzle which carries out the regurgitation of the ink of the color of said middle lightness to the same dot location in any [of said 1st and 2nd sense] case, The ink jet printer characterized by being what outputs a regurgitation pulse to said ink jet head so that ink may be breathed out in order of

the nozzle which carries out the regurgitation of the ink of said brightest color.

[Claim 2] Said ink jet head So that the nozzle which carries out the regurgitation of the ink of the darkest color may be located in the upstream of the nozzle which carries out the regurgitation of the ink of the color of middle lightness even when it moves to which sense of said main scanning direction It comes to arrange in a main scanning direction at least two or more one side of the nozzle which carries out the regurgitation of the ink of the color of the nozzle which carries out the regurgitation of the ink of said darkest color, and said middle lightness. Said head control means As opposed to the nozzle which carries out the regurgitation of the ink of said darkest color when said ink jet head is moving said main scanning direction to the 1st sense The ink jet printer according to claim 1 characterized by being what outputs a regurgitation pulse to the nozzle which carries out the regurgitation of the ink of the color of said middle lightness after outputting a regurgitation pulse.

[Claim 3] Said ink jet head consists of six head segments on a par with said main scanning direction which consisted of two or more nozzles with which each changed the location of the direction of vertical scanning. It has 2 sets of two head segments which carry out the regurgitation of the ink of the darkest color and the brightest color, respectively. It is the nozzle to which each class is arranged outside, respectively and two inside head segments carry out the regurgitation of the ink of the color of middle lightness. Said head control means The head segment which carries out the regurgitation of the ink of the darkest color of the group to precede about the same dot formation location, The ink jet printer according to claim 2 characterized by being what outputs a regurgitation pulse in order of the head segment which carries out the regurgitation of the ink of the color of middle lightness, and the head segment which carries out the regurgitation of the ink of the brightest color of a back group.

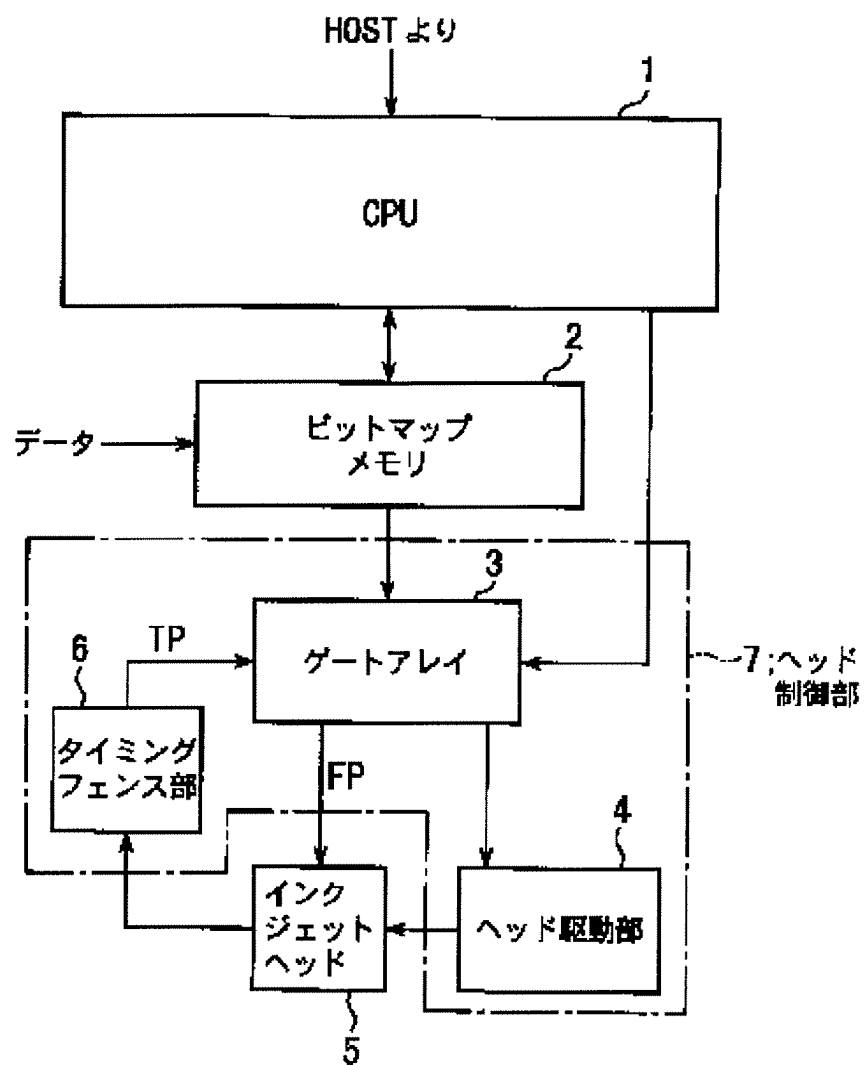
[Claim 4] Said ink jet head consists of four head segments on a par with said main scanning direction. Two head segments which carry out the regurgitation of the ink of the brightest color are arranged outside, respectively. Two inside head segments are head segments which carry out the regurgitation of the ink of the color of middle lightness. Said head control means The ink jet printer according to claim 1 characterized by being what outputs a regurgitation pulse about the same dot formation location in order of the head segment which carries out the regurgitation of the ink of the color of middle lightness, and the head segment which carries out the regurgitation of the ink of the brightest color behind that.

[Claim 5] The ink jet printer of claims 1-4 given in any 1 term with which said brightest color is characterized by the colors of yellow (Y) and said middle lightness being cyanogen (C) and a Magenta (M).

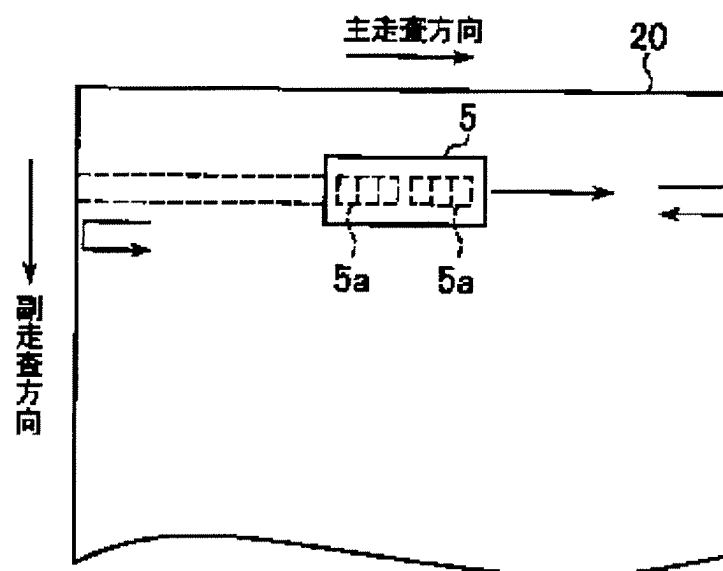
[Claim 6] The ink jet printer according to claim 2 or 3 with which said darkest color is characterized by black (K) and said brightest color being [the color of yellow (Y) and said middle lightness] cyanogen (C) and a Magenta (M).

[Claim 7] It is the ink jet printer according to claim 3 characterized by being what outputs a regurgitation pulse by turns to the head segment of the black by which said darkest color is black (K) and said head control means is included in said each class at the time of monochrome printing, and realizes printing of a twice [at the time of color printing] as many rate as this.

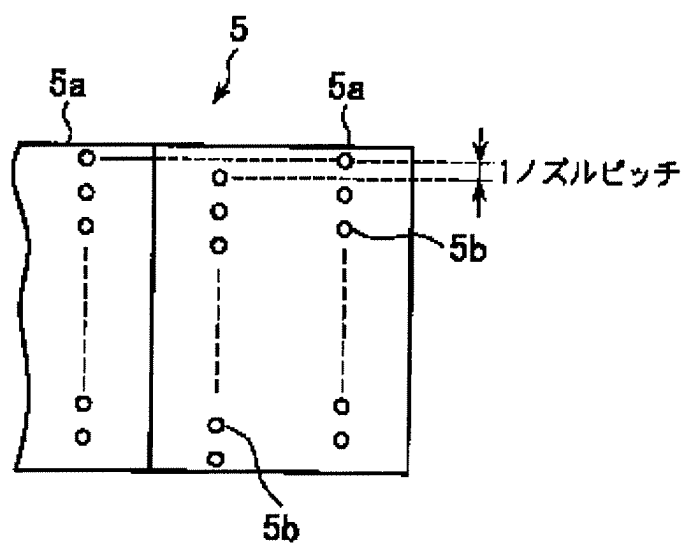
[Drawing 1]



[Drawing 2]

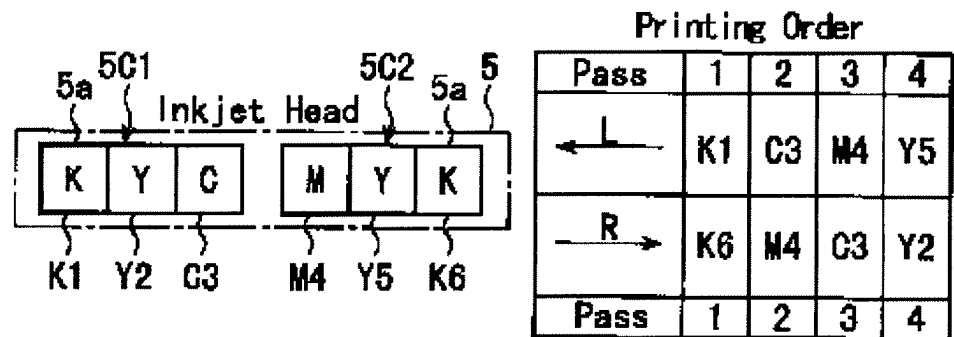


[Drawing 3]

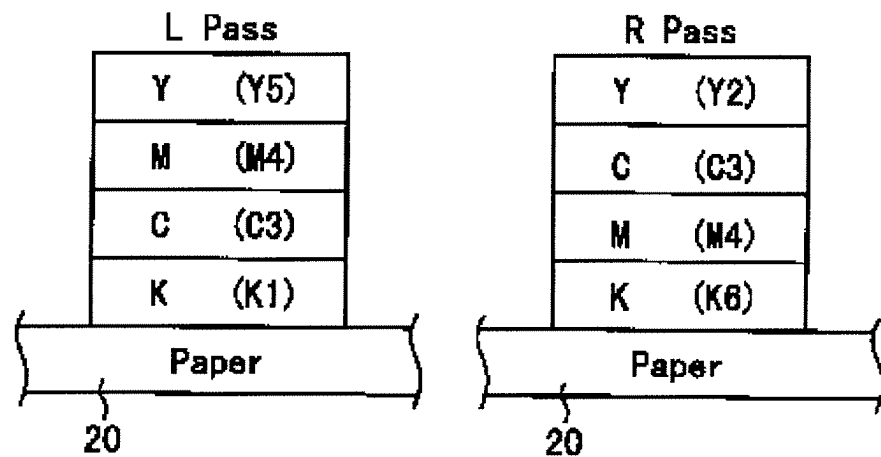


[Drawing 4]

(a)

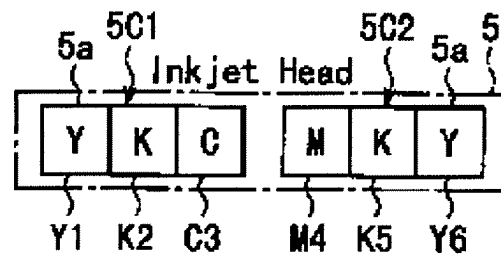


(b)



(a)

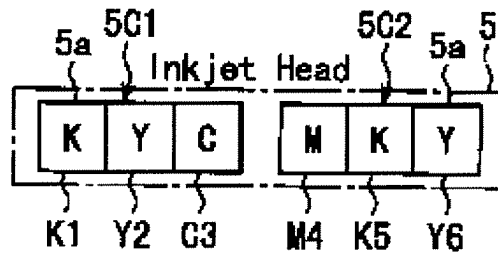
[Drawing 5]



Printing Order

Pass	1	2	3	4
L ←	K2	C3	M4	Y6
→ R	K5	M4	C3	Y1
Pass	1	2	3	4

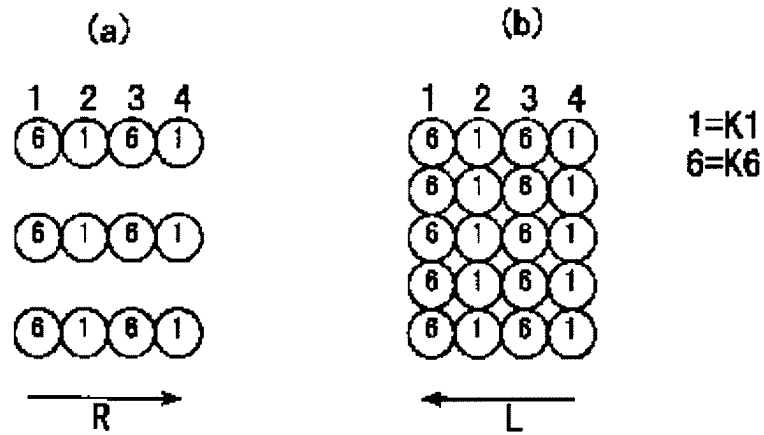
(b)



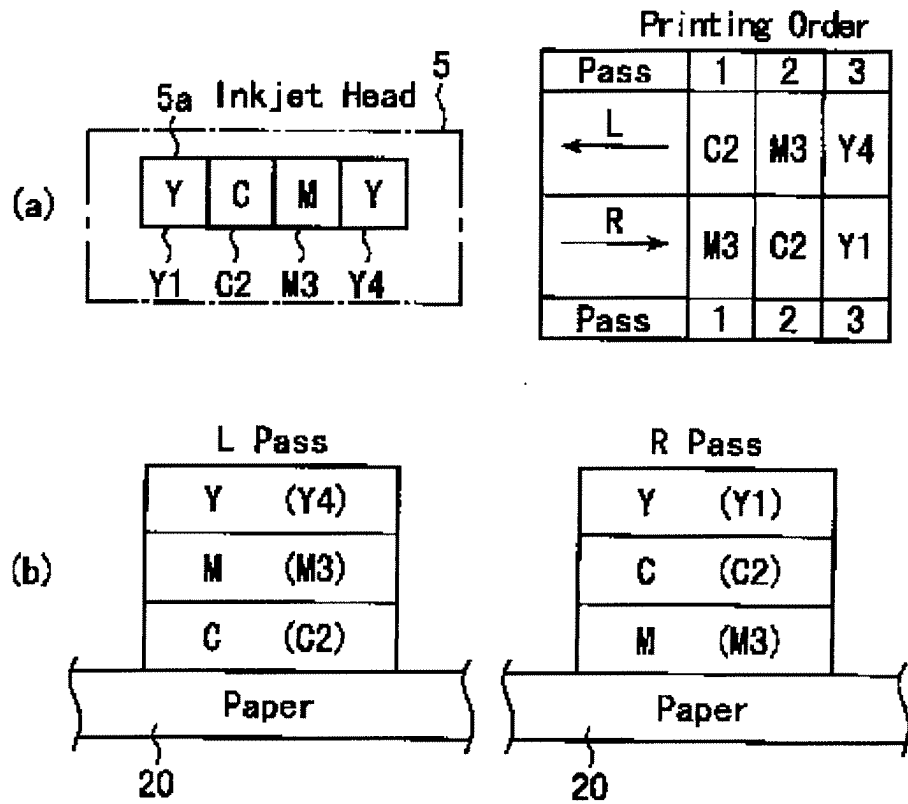
Printing Order

Pass	1	2	3	4
L ←	K1	C3	M4	Y6
→ R	K5	M4	C3	Y2
Pass	1	2	3	4

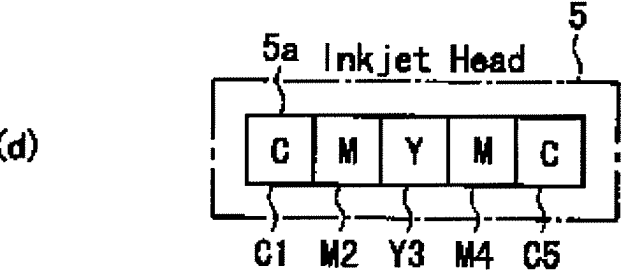
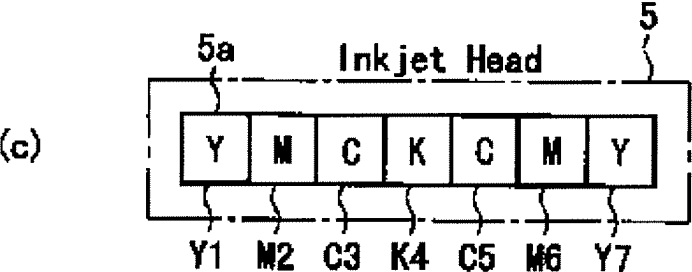
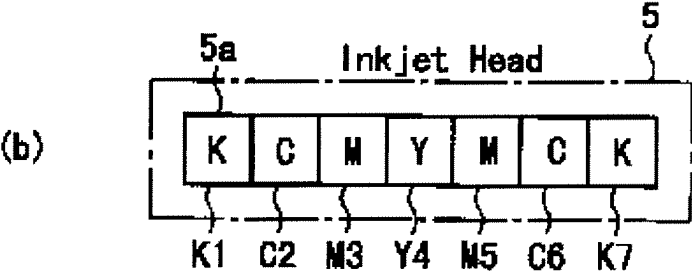
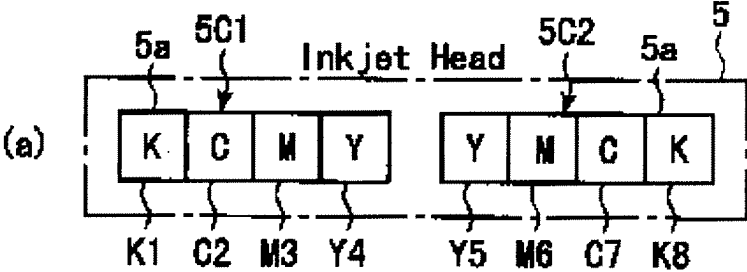
[Drawing 6]



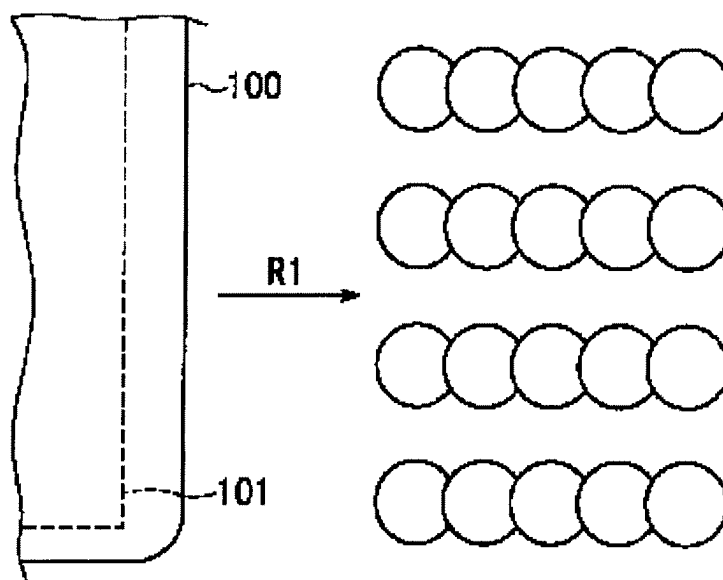
[Drawing 7]



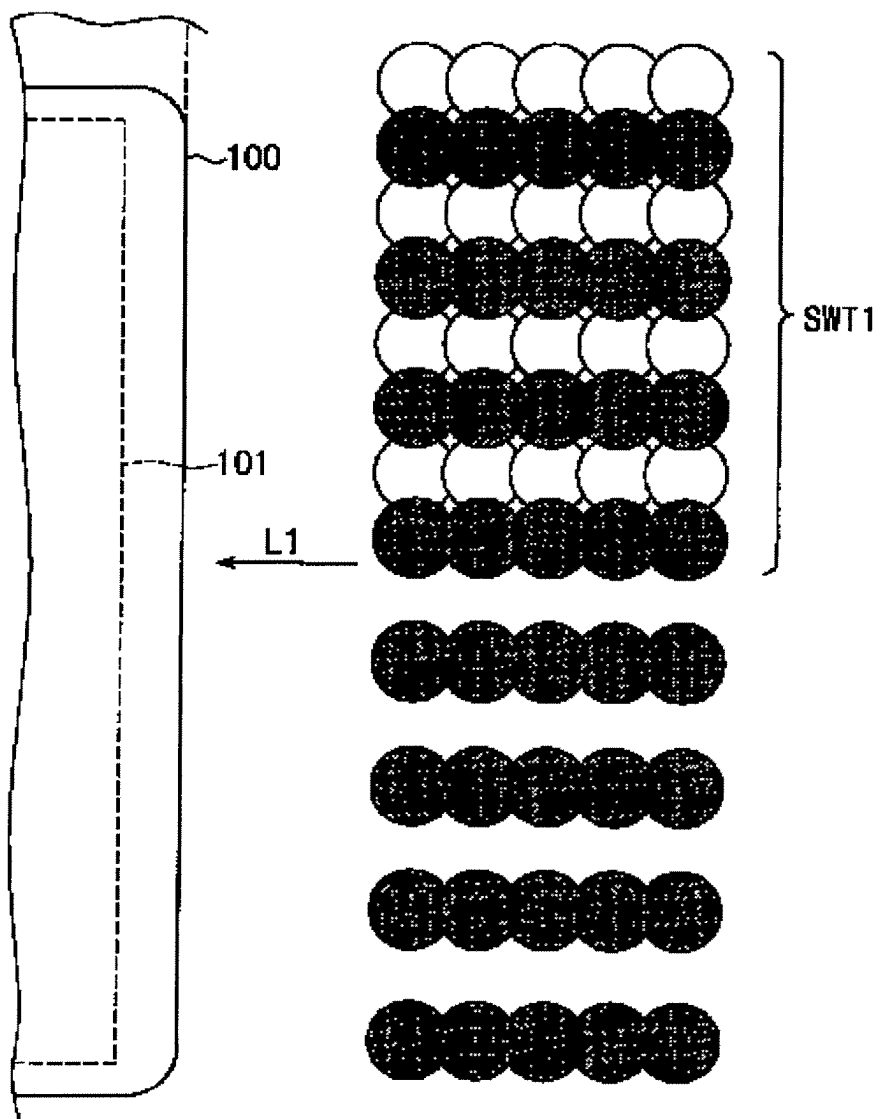
[Drawing 8]



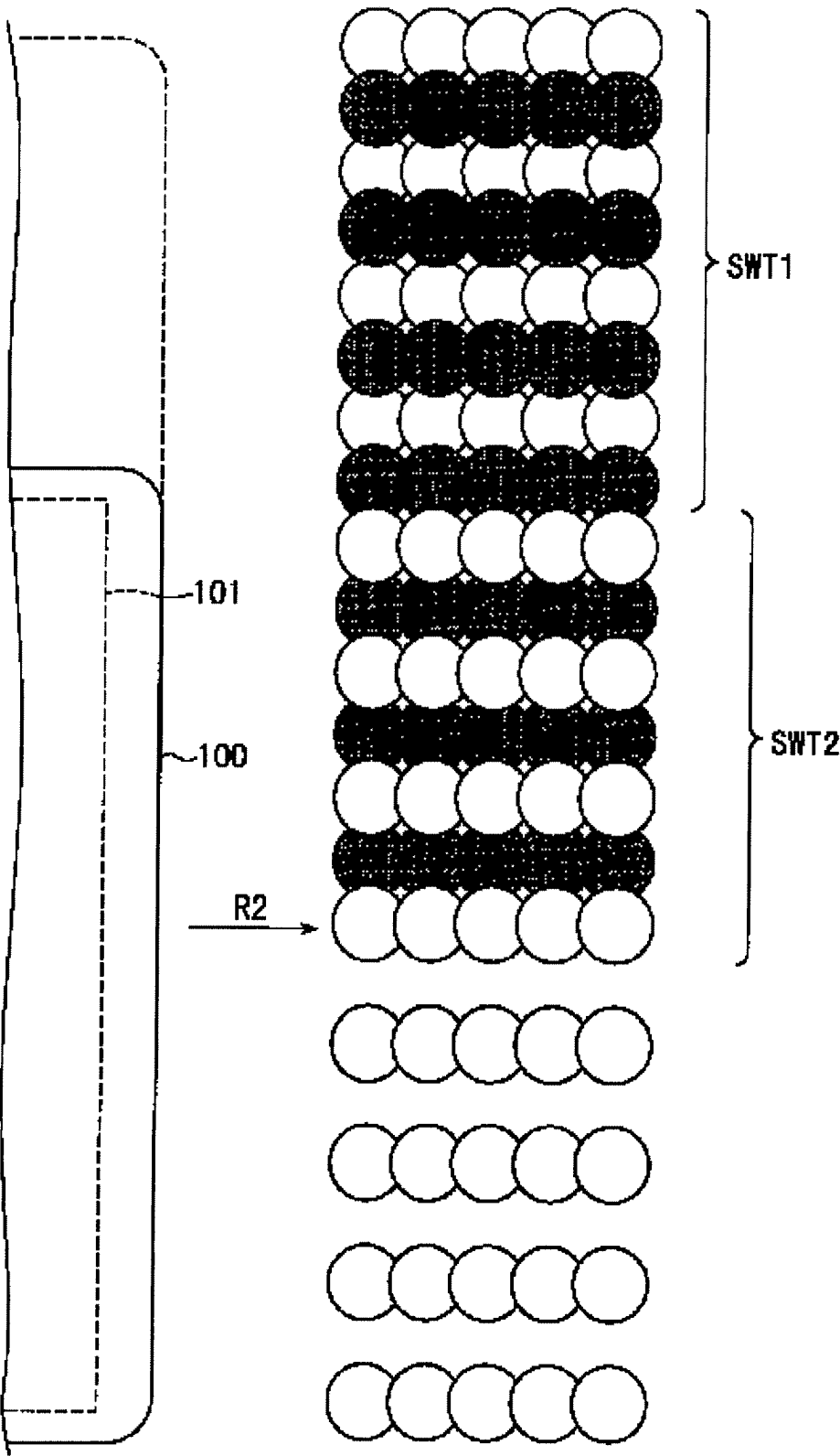
[Drawing 9A]



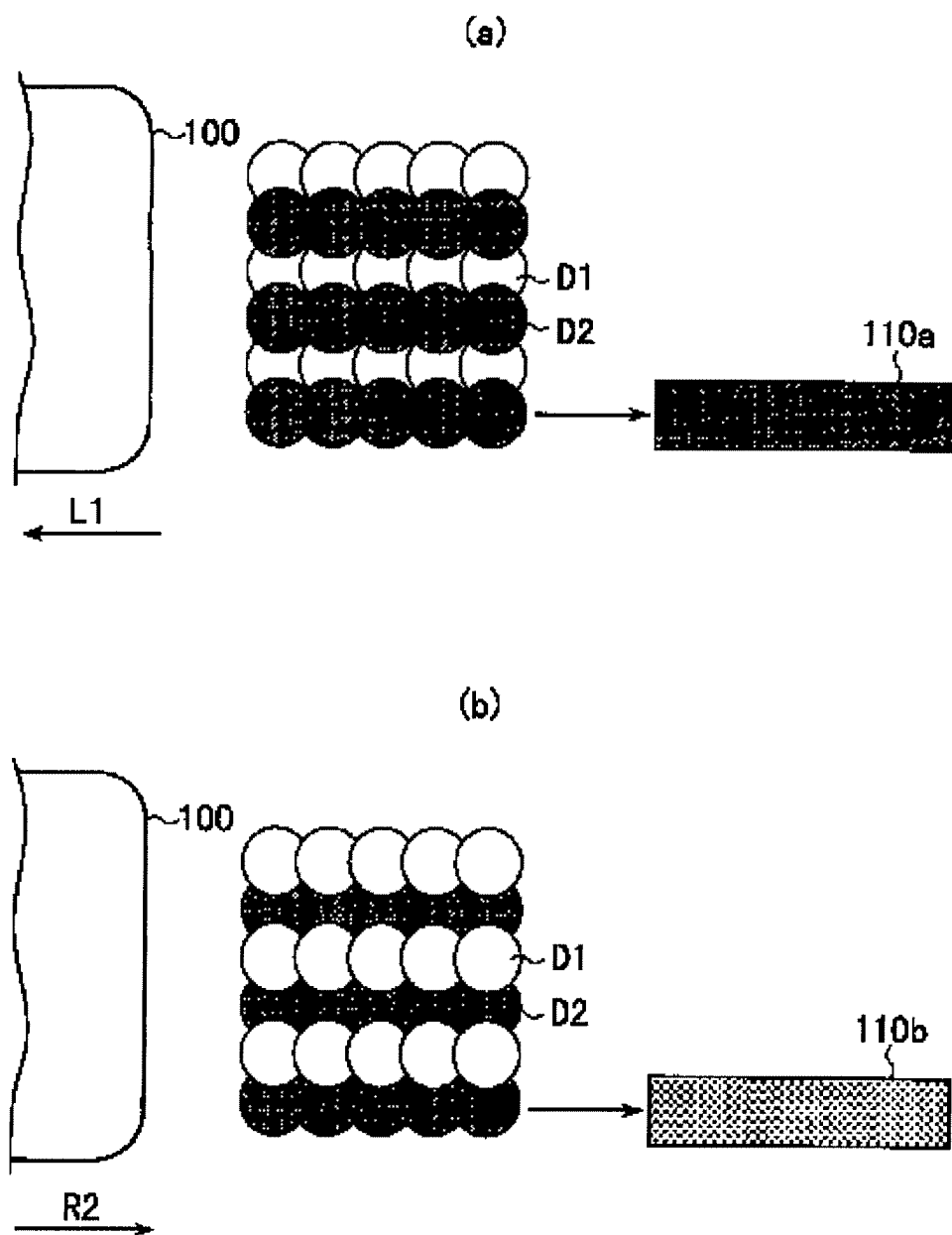
[Drawing 9B]



[Drawing 9C]



[Drawing 10]



X. RELATED PROCEEDINGS APPENDIX

Not used.